

CLAIMS

What is claimed is:

- 1 1. A pixel-registered photo detector array comprising:
 - 2 one or more detector layers of semiconductor material, each detector layer between
 - 3 contact layers of semiconductor material, thereby defining a stack of layers
 - 4 having a front side and a back side; and
 - 5 a waffle-type light-coupling grating formed on the backside of the stack, the grating
 - 6 having a pattern of holes that reflects a substantial portion of light coming
 - 7 into the array so as to disperse that light through the one or more detector
 - 8 layers, thereby facilitating absorption.
- 1 2. The array of claim 1 wherein the pattern of the waffle-type light-coupling
- 2 grating has a geometry optimized for a center wavelength of interest, and an orientation
- 3 ranging from about 20 to 70 degrees.
- 1 3. The array of claim 2 wherein the geometry includes a hole depth of about
- 2 one quarter wavelength of the center wavelength of interest, and a spacing between the
- 3 holes of about the center wavelength of interest.
- 1 4. The array of claim 2 wherein the orientation is about 45 degrees.
- 1 5. The array of claim 1 wherein the array has a plurality of detector layers,
- 2 each having a different light absorption versus wavelength response curve thereby enabling
- 3 a multicolor photo detector.
- 1 6. The array of claim 1 wherein edges of the one or more detector layers are
- 2 reflectively coated so as to provide, in conjunction with the waffle-type light-coupling
- 3 grating, a photon-in-a-box configuration for containing light within each pixel of the array.
- 1 7. The array of claim 1 wherein the waffle-type light-coupling grating includes
- 2 a hybrid metal layer having both ohmic and reflective qualities.

1 8. The array of claim 1 wherein each of the one or more detector layers is
2 about one micron or less in thickness.

1 9. The array of claim 1 wherein each of the contact layers is electrically
2 coupled to a respective electrical contact on the backside, thereby facilitating hybridization
3 where the array is connected to a substrate configured with supporting electrical circuitry.

1 10. The array of claim 1 wherein the array is configured as a strained-
2 InGaAs/AlGaAs QWIP structure having a limited number of quantum wells so as to enable
3 exploitation of avalanche effects.

1 11. A pixel-registered photo detector array comprising:

2 one or more detector layers of semiconductor material, each detector layer between
3 contact layers of semiconductor material, thereby defining a stack of layers
4 having a front side and a back side;

5 a light-coupling grating formed on the backside of the stack with a hybrid metal
6 layer having both ohmic and reflective qualities, and having a pattern that
7 reflects a substantial portion of light coming into the array so as to disperse
8 that light through the one or more detector layers, thereby facilitating
9 absorption;

10 wherein edges of the one or more detector layers are reflectively coated so as to
11 provide, in conjunction with the light-coupling grating, a photon-in-a-box
12 configuration for containing light within each pixel of the array.

1 12. The array of claim 11 wherein the pattern of the light-coupling grating is a
2 waffle-type grating and has a geometry that includes a hole depth of about one quarter
3 wavelength of a center wavelength of interest, and a spacing between the holes of about the
4 center wavelength of interest.

1 13. The array of claim 11 wherein the pattern of the light-coupling grating has
2 an orientation of about 45 degrees.

1 14. The array of claim 11 wherein the array has a plurality of detector layers,
2 each having a different light absorption versus wavelength response curve thereby enabling
3 a multicolor photo detector.

1 15. The array of claim 11 wherein each of the one or more detector layers is
2 about one micron or less in thickness.

1 16. The array of claim 11 wherein each of the contact layers is electrically
2 coupled to a respective electrical contact on the backside, thereby facilitating hybridization
3 where the array is connected to a substrate configured with supporting electrical circuitry.

1 17. A pixel-registered photo detector array comprising:
2 one or more detector layers of semiconductor material, each detector layer between
3 contact layers of semiconductor material, thereby defining a stack of layers
4 of a multicolor photo detector having a front side and a back side;
5 a rotated light-coupling grating formed on the backside of the stack, the light-
6 coupling grating having a pattern that reflects a substantial portion of light
7 coming into the array so as to disperse that light through the one or more
8 detector layers, thereby facilitating absorption.

1 18. The array of claim 18 wherein the rotated light-coupling grating has an
2 orientation of about 45 degrees, and has one of a waffle-type or post-type pattern.

1 19. The array of claim 18 wherein the light-coupling grating includes a hybrid
2 metal layer having both ohmic and reflective qualities, and edges of each detector layer are
3 reflectively coated so as to provide, in conjunction with the light-coupling grating, a
4 photon-in-a-box configuration for containing light within each pixel of the array.

1 20. The array of claim 18 wherein the array is configured as a strained-
2 InGaAs/AlGaAs QWIP structure having a limited number of quantum wells so as to enable
3 exploitation of avalanche effects.